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Studies on Some Stress Factors Affecting Respiratory Efficiency in Fish

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Summary

Aquatic ecosystems are exposed to changes in the environmental conditions and excessive input of pollutants and contaminants from various sources like domestic and industrial sewage, agricultural processes, heavy metals and others which changes the natural quality of water, where water quality is an important part of any aquaculture system which plays a main role in fish health and any alteration in water quality causes stress to fish and leads to adverse effects on growth, reproduction, immunity, flesh quality and production.

Because of the economic importance of *Oreochromis niloticus* in aquaculture in Egypt, so this study aims to investigate the effect of some stress factors like temperature, ammonia and salinity on respiratory efficiency in addition to assessment of respiratory, acid-base balance, haematological parameters, gene expression of Na⁺- K⁺- ATPase and carbonic anhydrase and histological changes in Nile Tilapia, *Oreochromis niloticus* to avoid their adverse effects and increase production.

After being acclimatized 1[^]0 male Nile Tilapia (*Oreochromis niloticus*) fish with mean weight of 200 ± 20 gm were divided into (18 glass aquaria, 10 fish each) as follow:

Group I: Control group, kept under optimal and normal environmental conditions.

Group II: High temperature (HT): Fish were exposed to temperature 31 C° for 10 days.

Group III: Low ammonia (Am.5): Fish were treated with 5 mg/l ammonium chloride (NH₄CL) for 10 days.

Group IV: High ammonia (Am.10): Fish were treated with 10 mg/l ammonium chloride (NH₄CL) for 10 days.

Group V: Low salinity (S10): Fish were exposed to 10 ppt (g/l) sodium chloride for 10 days.

Group V: Low salinity (S10): Fish were exposed to 10 ppt (g/l) sodium chloride for 10 days.

Mortality rate and dissolved oxygen were measured

Blood samples were collected from the dorsal aorta using heparinized tubes for the determination of blood gases (pH, PO₂, PCO₂, TCO₂ and HCO₃), electrolytes (Na⁺, K⁺ and Ca⁺⁺) and lactate.

Another blood samples were obtained from the caudal blood vessels of each fish. The collected blood was divided into two tubes, one containing EDTA as an anticoagulant for haematological assessment (packed cell volume (PCV) and haemoglobin (Hb)) and the other one is without anticoagulant for separating serum. Serum samples were stored at -20°C for biochemical analysis of cortisol, triiodothyronine (T_3), free triiodothyronine (FT_3) and malondialdehyde (MDA).

Tissue specimens from gills, liver and kidney were then kept in jars containing 10% formalin for histopathological examination. Another samples from gills were put in a 1ml eppendorff tube and immediately embedded in liquid nitrogen then stored at -80°C for gene expression.

The results showed:

- 1- Mortality rates were recorded to be 50%, 33.3%, 23.3%, 20%, 13.3% in Am.10, HT, Am.5, S15 and S10 groups respectively within 10 days.
- 2- Significant differences ($P<0.05$) for Do, pH, PO_2 , PCO_2 , TCO_2 , HCO_3^- were noticed in different groups after 5 and 10 days.
- 3- Significant differences ($P<0.05$) were observed in Hb, PCV, Na^+ , K^+ , Ca^{++} and lactate among different treatments.
- 4- It was found a significant increase ($P<0.05$) in serum cortisol, triiodothyronine and free triiodothyronine concentrations after 5 and 10 days in all groups in comparison to the control group.
- 5- Serum MDA showed a significant increase ($P<0.05$) after 5 days in all groups, then became non-significant after 10 days compared to the control group.
- 6- A significant increase ($P<0.05$) in gene expression of Na^+ - K^+ - ATPase was in all groups while gene expression of cytosolic carbonic anhydrase showed a significant increase ($P<0.05$) in all groups, after 10 days as compared with the control group.
- 7- Alterations of different types were detected in the histology of gills, liver and kidney of different groups.

The results of this study showed that high temperature, ammonia and salinity led to stress that affected and changed respiratory, acid base, haematological, biochemical parameters, expression of some genes and histological features to adapt the environmental changes to overcome oxidative stress. However, some fish could not tolerate these stressors and died, consequently the growth, reproduction, immunity, flesh quality and production of fish will be affected and this in turn leads to economic losses of aquaculture. So, these results give useful information for improvement of the management practices in aquaculture and monitoring changes in the health status of fish.